

Design of Winding and Unwinding Control for High-speed Slitter

Songzhe Pan, Jialiang Hu, Kangwei Xiao, Panpan Liu, Yu Chen

Wenzhou Polytechnic, Wenzhou, 325200, Zhejiang, China

Abstract: The technical gap between China's slitter and some international brands in tension control is obvious, highlighting the shortcomings of unstable tension control, slow speed and low automation level. This paper is mainly about the research and analysis of the existing domestic slitter winding and unwinding technology, and analyzes the technical gap from the winding and unwinding system.

Keywords: Slitter, Winding mechanism, Unwinding mechanism, Tension control, Speed control.

1. Introduction

With the rapid development of the economy, people's requirements for the quality of film, paper and textile continue to improve. There is still a big gap between domestic slitter equipment and foreign equipment, specifically manifested in the low precision of tension control, and the material is greatly affected by tension in slitting, unwinding and winding. The tension determines the removal effect of material burrs, the uniformity of slitting end face and the quality of winding products. Therefore, the research and analysis of slitter winding and unwinding mechanism has important economic significance for relevant industries[1-2].

This paper summarizes the theoretical knowledge of the rewinding and unwinding mechanism in hardware and software, tension control algorithm and other aspects through the study of the rewinding and unwinding of the high-speed slitter. It is hoped that it can be compared with foreign slitter technology, absorb advantages and make up for disadvantages, and promote the development of domestic slitter technology.

2. Overall Research and Analysis of Winding and Unwinding Mechanism

Through the overall study of the high-speed slitter, the modular analysis is carried out here. Each module of the slitter acts on the winding and unwinding mechanism. The tension sensor, meter meter meter, winding diameter sensor of the data acquisition input module, the PLC of the control module, the frequency converter of the data receiving module, the electric control proportional valve, the tension controller, etc., and the various rollers of the execution module form the winding and unwinding mechanism of the slitter. The winding-up and unwinding mechanism is a system to control the permanent and constant tension, so as to ensure that the slitting material will not break and wrinkle at any speed of the slitter.

3. Hardware Analysis of Winding and Unwinding Mechanism

(1) Sensor analysis

1) The tension sensor is a contact tension sensor in the winding and unwinding mechanism, which changes the resistance through pressure, converts the tension into electrical signal, and dynamically monitors the tension of the cutting material[3];

2) The meter is used for precise length measurement of cutting materials, and the collected data is input to the control module in the form of pulse[4];

3) The unwinding coil diameter sensor collects the information of unwinding coil diameter in the form of analog data for later monitoring.

(2) Analysis of tension controller

1) Magnetic powder control: apply the magnetic powder brake on the unwinding mechanism, use the mutual force generated by magnetic powder magnetization to generate braking torque, and the output of magnetic powder is controlled by 0~10V analog signal[5];

2) Pneumatic control: the electronic proportional valve will control the air pressure of the air bag in the slip shaft of the winding mechanism, which is the same as the magnetic powder brake, and is controlled by the analog signal[6].

(3) Perform module analysis

The frequency converter receives the analog signal sent after the conversion from the PLC, and gives the corresponding speed[7] to drive each roller to rotate, so that the slitting material can realize the functions of winding, traction, winding, etc. It has the function of speed control. The structure diagram is shown in Figure 1.

4. Software Analysis of Winding and Unwinding Mechanism

As the core of the whole system, the control module is mainly a programmable controller that controls the whole equipment. Complete the program in PLC in advance, and then process and output the received data so that the equipment can operate according to the established requirements. The general flow chart of the program is shown in Figure 2. The winding and unwinding mechanism can respond to the received command signal and carry out the winding and unwinding of the slitting material at the set speed and tension.

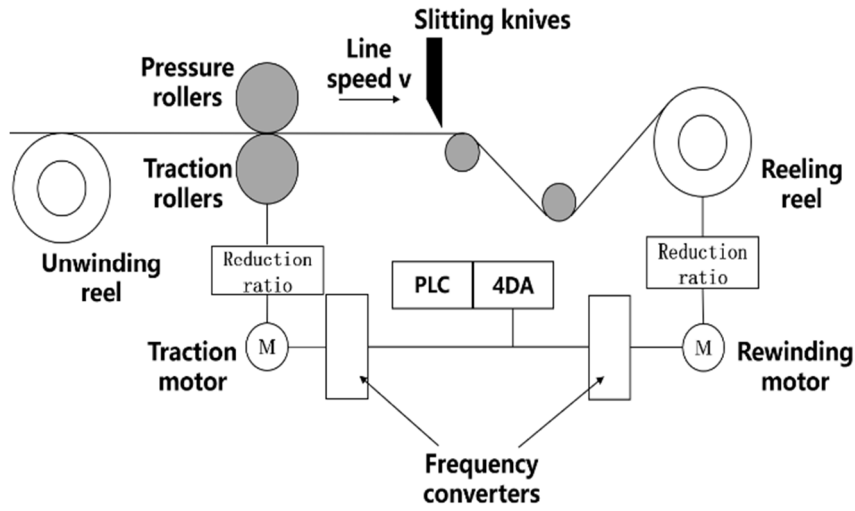


Figure 1. Schematic diagram of execution module structure

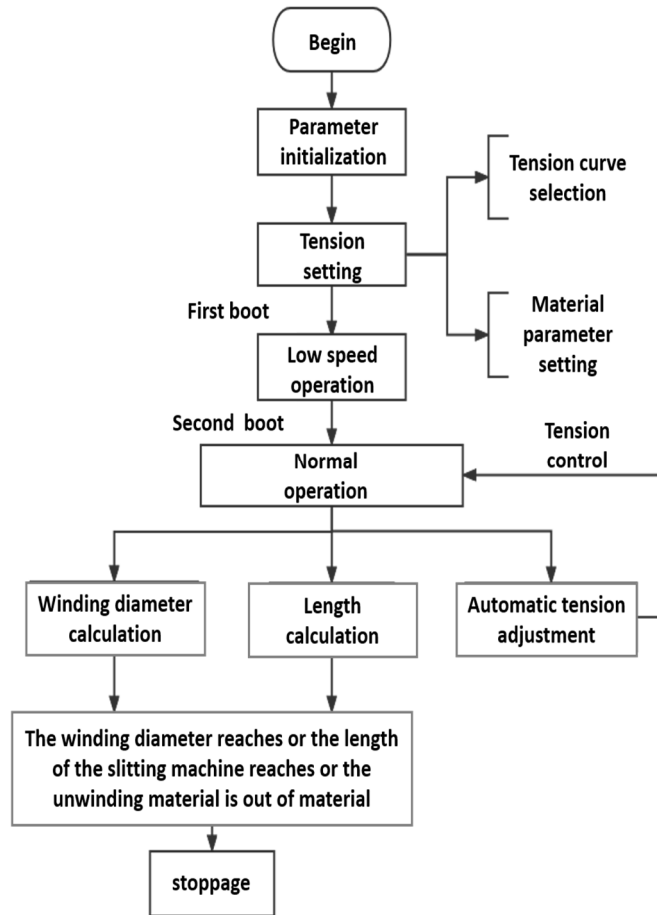


Figure 2. Procedure flow chart

5. Analysis of Tension Algorithm of Winding and Unwinding Mechanism

The existing tension control methods mainly include torque control and speed control.

1) Torque control: control the output torque of the motor to change with the coil diameter, so as to keep the tension constant. The specific algorithm is as follows:

$$F = T_Z / R \quad (1)$$

Where: F is the tension of the material; T_Z is the tension torque; R is the winding radius.

2) Speed control: keep the speed constant by detecting the linear speed, and change the tension by changing the mechanical configuration,

The specific algorithm is as follows:

$$F = W / 2 \quad (2)$$

Where: F is the tension of the material; W is the weight of the mechanical configuration.

6. Conclusion

With the development of domestic slitter, the slitter technology is becoming more and more mature. I believe that some knowledge of winding and unwinding technology summarized in this article will help us understand the current situation of domestic slitter technology. Through the analysis of existing deficiencies and continuous improvement, the cutting quality will become better and better in the future, and the occurrence of folds and fractures will also be greatly reduced.

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